FIRST RECORDS OF *MYRMICA VANDELI* BONDROIT (HYMENOPTERA, FORMICIDAE) FOR BRITAIN

G.W. Elmes[1], A.G. Radchenko[2] & J.A. Thomas[1]

[1]*NERC, Centre for Ecology and Hydrology, Winfrith Technology Centre, Dorset DT2 8ZD, UK. e-mail: gwe@ceh.ac.uk or jat@ceh.ac.uk* [2]*Museum and Institute of Zoology, Polish Academy of Sciences, 64, Wilcza str., 00-679, Warsaw. e-mail: rad@public.icyb.kiev.ua*

Abstract. Details of two colonies of *Myrmica vandeli* Bondroit, found in South Wales and southern England are reported. Drawings of *M. vandeli* together with a table of key features illustrate how all castes can be separated from the closely related species, *Myrmica scabrinodis* Nylander and *Myrmica sabuleti* Meinert. The biology and ecology of *M. vandeli* are outlined and it is suggested that it might be a temporary social parasite of *M. scabrinodis* colonies.

Introduction

Myrmica vandeli Bondroit was described from queens and males from the Jura (Bondroit, 1920). It was known only from the type series until Kutter (1977) found a free-living colony near Neuchâtal, Switzerland. Queens of *M. vandeli* have a relatively wide postpetiole, tibial spurs with reduced pectination, and are quite hairy. These characteristics, that are often present in socially parasitic *Myrmica*, led some to speculate that they might be social parasites of *Myrmica lobicornis* Nylander (e.g. see Bernard, 1967). The exact status of *M. vandeli* remained uncertain until Elmes & Thomas (1985) reported a large population of free-living colonies, co-existing with *Myrmica scabrinodis* Nylander, in the Upper Rhone Valley and the Massif Central of France. Since then, *M. vandeli* has been recorded from Germany, Switzerland and the Czech Republic (Seifert, 1988, 1996), parts of former Yugoslavia and Turkish Thrace (Agosti & Collingwood, 1987), Romania (Markó, 1999) and Austria (Sehliek-Steiner & Steiner, 2000). From these records *M. vandeli* would appear to be a free-living, submontane species of central and south-eastern Europe.

Colonies of *M. vandeli* can very easily be mistaken for those of *M. scabrinodis* because the workers of the two species are superficially very similar. The queens of *M. vandeli* are significantly larger and generally much darker than those of *M. scabrinodis* (see Elmes & Thomas, 1985). However, the males are very obviously different, those of *M. vandeli* having relatively long antennal scapes, like those of *Myrmica sabuleti* Meinert (see Elmes & Thomas, 1985). In our experience as field ecologists, we have usually first recognised *M. vandeli* after being puzzled by finding '*M. sabuleti*' males in a '*M. scabrinodis*' nest.

This most recently occurred when we (Elmes & Thomas) were searching *M. scabrinodis* nests, living on Dorset heathlands, for the presence of larvae of the parasitic hoverfly *Microdon myrmicae* Schönrogge *et al.* (see Schönrogge *et al.*, 2000). At about the same time Radchenko was working on the Elmes Collection of *Myrmica*, in preparation for a taxonomic revision of the Eurasian *Myrmica* species, and discovered a colony series of *M. vandeli* taken by Elmes in 1983, from Pembrokeshire, South Wales. In this paper we formally record these finds and give information to help other British entomologists find *M. vandeli* and distinguish it from *M. scabrinodis*.

The British Material

Colony 1: (Elmes coll. code GBW13), *M. vaudeli,* 19 workers, 20 alate queens, 24 males; Wern, near Punceston, Pembrokeshire, South Wales (SN015305), leg. Elmes 1 Sept. 1983. In damp, well-grazed grassland, nest under piece of flat slate. Note, the sample from this colony also contained 14 *M. scabrinodis* workers, 2 of the males were intercastes and 5 males, including one of the intercastes, were visibly smaller than the others. A worker, queen and male were deposited (June 2002) in the collection of the Institut Royal des Sciences Naturelles de Belgique, Brussels, which holds the Bondroit type specimens of *M. vaudeli.* In 1983, Elmes determined this series as *M. sabuleti*, based on the males, with a note that the workers appeared to be *M. scabrinodis.*

Colony 2: (Elmes coll. code GB1281), *M. vaudeli*, 6 workers, 1 alate queen, 1 male; Oakers Wood, nr. Bryants Puddle, Dorset (SY803921), leg. Elmes 13 Oct. 1999. Nest in an open area of wet-heath, under a power-line but well sheltered by surrounding woodland, living in a *Molinia* tussock. Note, this nest series also contained 6 *M. scabrinodis* workers.

Identification of *M. vandeli*

Traditionally a range of morphometrics and indices calculated from them are used in the discrimination of *Myrmica* species (e.g. Sadil, 1952; Elmes, 1978; Seifert, 1988). Generally, we have used 19 measurement and 16 indices in our recent treatments of *Myrmica* (e.g. Elmes, Radchenko & Aktaç, 2002). Eleven morphometrics were used by Elmes & Thomas (1985) in a discriminant analysis between *M. vaudeli, M. scabrinodis, M. sabuleti* and *Myrmica hirsuta* Elmes (a social parasite of *M. sabuleti* nests). They showed that only three of the measurements were sufficient to discriminate workers and queens of *M. vaudeli* from those of *M. scabrinodis*, being post-petiole width [PPW] and number of hairs on the petiole [H], plus head-width measured behind the eyes [HW] in the case of queens, or the minimum distance between the frontal ridges [frons-width, FW] in the case of workers. Similarly, only three measurements (PPW, Post-petiole height [PPH] and H) were required to discriminate between *M. vaudeli* and *M. sabuleti* males. The discrimination functions were:

Queens
Discriminant = 0.19 H + 13.46 PPW + 11.91 HW − 25.89
M. scabrinodis < −0.91 > *M. vaudeli* Confidence 99.8%
Workers
Discriminant = 0.42 H + 33.09 PPW + 53.10 FW − 9.69
M. scabrinodis < −0.20 > *M. vaudeli* Confidence 99.5%
Males
Discriminant = 30.63 PPH − 25.23 PPW − 0.34 HW + 1.96
M. vaudeli < 1.32 > *M. sabuleti* Confidence 99.9%

First separating the workers colonies 1 and 2 into *M. vaudeli* and *M. scabrinodis*, based upon the sculpture of the alitrunk (see below), and then applying the above discriminant function, we obtained mean discriminant values of 2.09 for *M. vaudeli* workers from Pembroke, and 3.01 for workers from Dorset, confirming our more subjective identification with a very high confidence. Similarly, mean discriminant values of −2.31 and −1.83 for the *M. scabrinodis* workers confirmed with a high

degree of confidence that they were indeed *M. scabrinodis*. Mean discriminant values of 0.65 and 1.93 (single specimen) for the queens in the two colonies confirmed them as *M. vaudeli*, whereas discriminant values of 3.85 and 3.53 (single specimen) for males showed that they were not *M. sabuleti*.

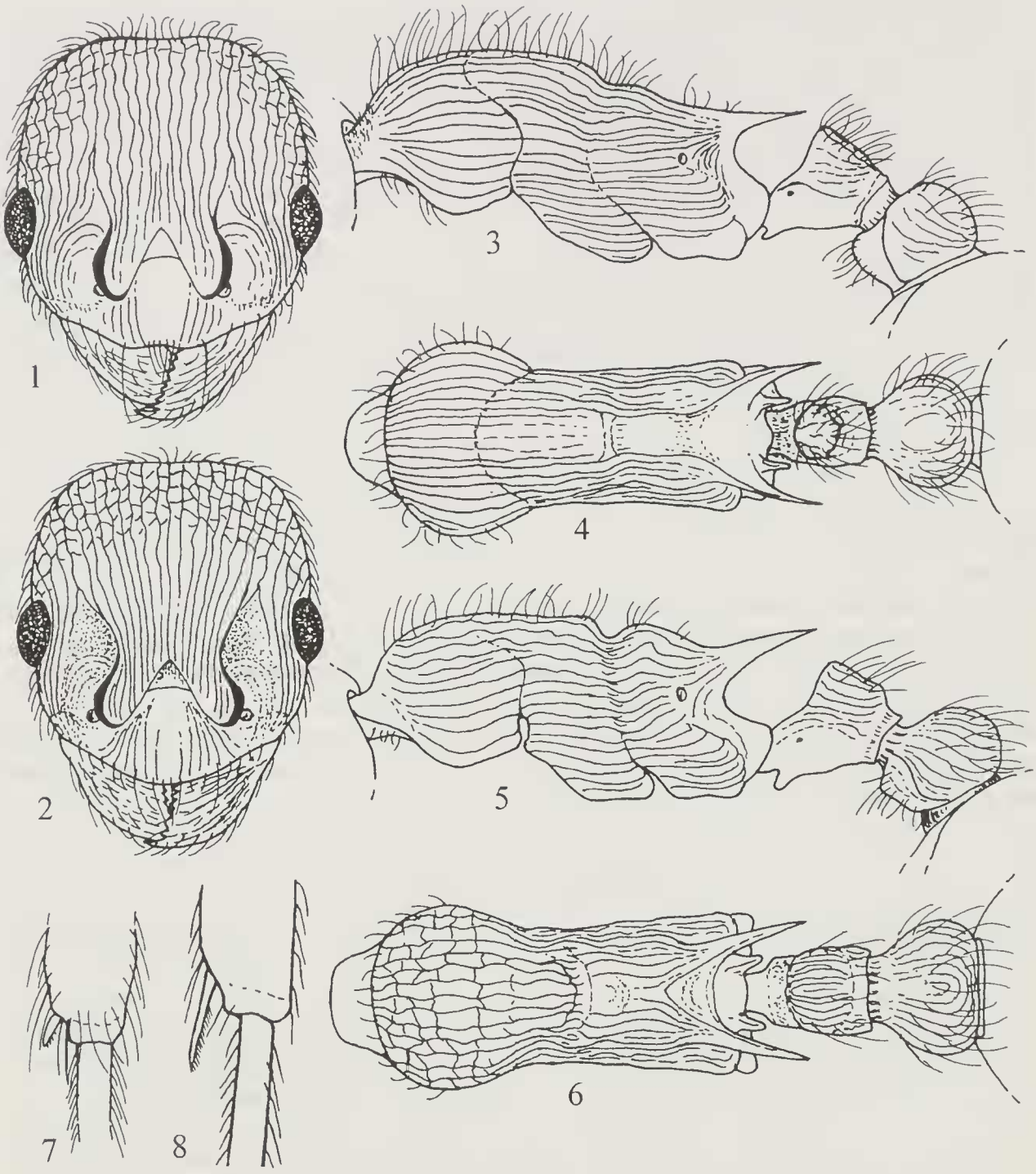
Although morphometrics and discriminant functions are useful to confirm whether a collector has samples of *M. vaudeli*, especially when one has not previously seen the species, *M. vaudeli* does have visibly distinctive features (Figs 1–18), which well separate it from *M. scabrinodis* and *M. sabuleti* (summarised as Table 1). If one uses only the traditional features of scape-lobe shape combined with frons-width, which in Britain well distinguishes *M. scabrinodis* from *M. sabuleti*, it is easy to confuse *M. vaudeli* workers with those of *M. scabrinodis*, even though the scape-lobe shapes generally differ (Figs 9–12). The most useful features which distinguish *M. vaudeli* from *M. scabrinodis* are the finer, less sinuous striation with less reticulation on the head and alitrunk combined with a greater pilosity in waist region, and, for more experienced observers, the notched anterior clypeal margin. Queens usually differ visibly due to their much greater size and dark colouring. Males clearly differ from those of *M. scabrinodis* by their longer scapes; initially they might be confused with those of *M. sabuleti* but obviously differ by the combination of much longer hairs on the head and scape and shorter hairs on the tibia (Figs 13–18). If taken without workers (e.g. in pitfall traps) it is difficult to separate *M. vaudeli* males from those of *M. hirsuta*, even the discrimination proposed by Elmes & Thomas (1985) could achieve a separation with only 84% confidence.

If one examines a large number of workers of any *Myrmica* species one finds a small proportion of pseudogynes (*sensu* Wheeler, 1910); most have only very vestigial traces of sutures for the scutum and scutellum on the pronotum, although a few can have vestigial wings. When examining material for this paper we noted that pseudogynes with very faint traces of sutures, are much more common in *M. vaudeli* (>50% in many series). In this respect they resemble some socially parasitic species (see Radchenko & Elmes, in press and below).

Mixed Colonies

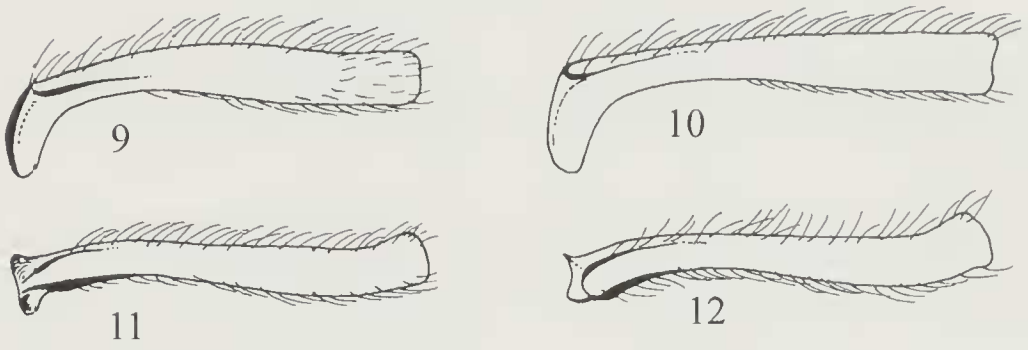
Both colonies sampled from Britain contained a mixture of *M. vaudeli* and *M. scabrinodis* workers: 58% *M. vaudeli* workers in Colony 1 and 50% in Colony 2. We are certain these were genuine mixed colonies and not the result of some sort of sampling mistake. We checked therefore, ca. 60 other colony series of *M. vaudeli*, held in the Elmes Collection, and found 4 that also contained some *M. scabrinodis*. These were from two sites in France. Forty-one nests were sampled from a wet meadow fed by a spring, near St. Bonnet in the Haute Alpes, 24 nests (60%) were *M. vaudeli* and the others were *M. scabrinodis*. None of the *M. scabrinodis* series contained *M. vaudeli* but 3 of the *M. vaudeli* contained *M. scabrinodis*, being 6 from 10 workers (60%), 1 from 4 workers (25%) and 1 from 3 males (even though all the workers in this nest series were *M. vaudeli*). Nineteen nests were sampled at a site near Le Puy in the Massif Central, 4 nests (31%) were *M. vaudeli*, one of which had a single *M. scabrinodis* among the series of 10 workers (10%). No mixed series were found from a third site, in the Upper Rhône valley, where we sampled 24 *M. vaudeli* and 111 *M. scabrinodis* nests.

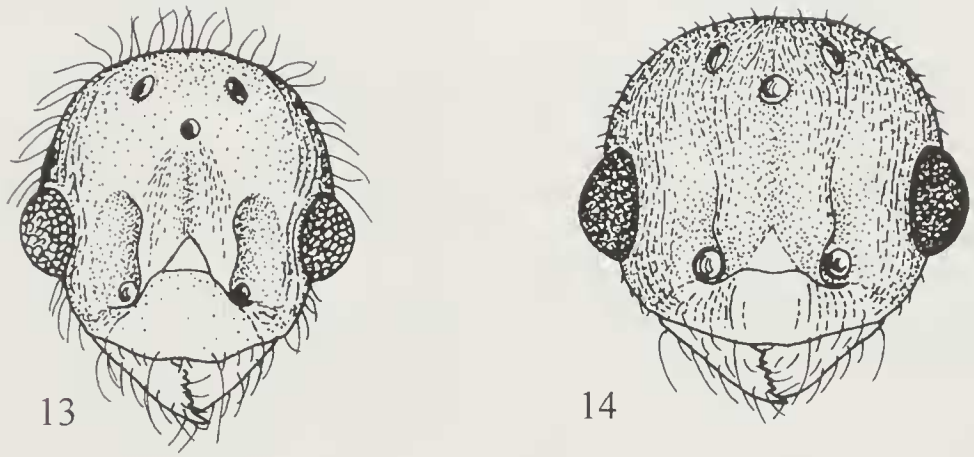
The most probable explanation for these observations is that *M. vaudeli* might be a temporary (perhaps facultative) social parasite of *M. scabrinodis*, not *M. lobicornis* as suggested by Bernard (1977). In many respects, such as reduced spurs and hairy body, and pseudogyne workers, *M. vaudeli* is morphologically similar to *Myrmica*

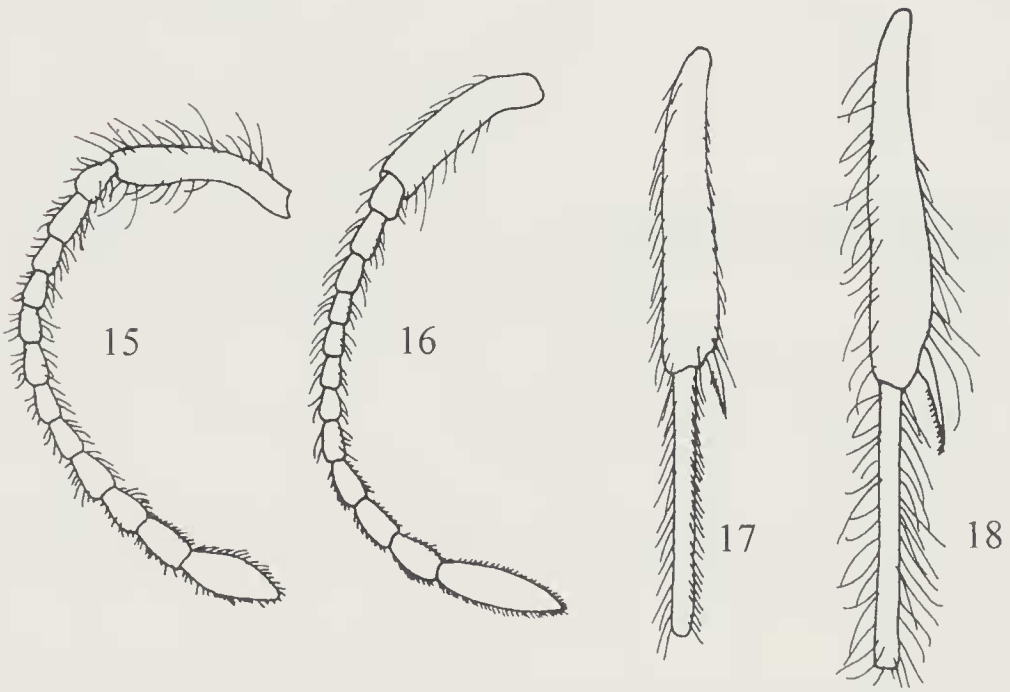


Figs 1–18 (above and opposite). *Myrmica vandeli* worker Figures 1, 3, 4, 7, 9 & 10; *M. vandeli* male Figures 13, 15 & 17; *M. scabrinodis* worker Figures 2, 4, 6, 8, 11 & 12; *M. scabrinodis* male Figures 14, 16 & 18. The *M. vandeli* worker is from the Welsh series (Colony 1), the male is a

0.5 mm (figs. 9 - 12)







1.0 mm (figs. 13 - 18)

paralectotype from Bondroit's collection (Brussels) ; the *M. scabrinodis* worker is the Lectotype from Nylander's collection (Helsinki) and the *M. sabuleti* male is a paralectotype from Meinert's collection (Copenhagen).

Table 1. Summary of the morphological differences between *Myrmica vandeli* and related species.

M. vandeli	*M. scabrinodis*
Workers	
More hairy than is typical for European *Myrmica* species: petiole usually with 10–20, sometimes more, long, thin and often curved hairs (Figs 3, 4)	Typical *Myrmica* pilosity; petiole with less than 10 , usually fewer than 8, long, straight, thick hairs (Figs 5, 6)
Anterior clypeal margin with a distinct notch (Fig. 1)	Anterior clypeal margin broadly rounded, with no notch (Fig. 2)
Alitrunk finely sculptured (Fig. 3): dorsum having fine, straight or slightly sinuous longitudinal rugae (Fig. 4)	Alitrunk coarsely sculptured (Fig. 5): pro-mesonotal dorsum usually reticulate or with coarse, strongly sinuous rugae (Fig. 6)
Petiole, and especially postpetiole seen from above, with reduced sculpture (Fig. 4)	Petiole and postpetiole dorsum with coarse sculpture (Fig. 6)
Spurs on middle and hind tibiae always poorly developed and usually with no pectination (Fig.7)	Spurs on middle and hind tibiae usually well developed and pectinate (Fig. 8), but can be more poorly developed in some specimens.
Lobe on antennal scape less well developed (Fig. 9) appearing more narrow and antennuated from above (Fig. 11)	Lobe generally more developed and appearing rounded from above (Figs 10, 12), in some populations lobe can be extremely well developed but in others less so, more like *M. vandeli*
Queens	
Large, headwidth >1.20 mm, usually >1.25 mm; dark in colour, often appearing almost black	Smaller queens, headwidth <1.20 mm, usually <1.15 mm; typical light brown *Myrmica* colour, though specimens from acid moorland habitats can be quite dark
Males	
Antennal scape length (SL) relatively long, usually >0.50 mm; average SL/HW $=0.60$	Scape length distinctly shorter, usually <0.40 mm; average SL/HW $=0.38$
M. vandeli	*M. sabuleti*
Head margins with long curved hairs (Fig. 13); antennal scape with long hairs (Fig. 15); tibiae and tarsi with relatively short hairs (Fig. 17)	Head margins with very short straight hairs (Fig. 14); antennal scape with short hairs (Fig. 16); tibiae and tarsi with long curved hairs (Fig. 18)
Postpetiole relatively wide and low, average PPW/PPH $=1.02$	Postpetiole relatively narrower and high; PPW/PPH $=0.96$

bibikoffi Kutter and *M. hirsuta*, both social parasites of *M. sabuleti* (see Radchenko and Elmes, in press). We hypothesise that the warm, moist condition (see below) at the Haute Rhône site probably represents the centre of the range of *M. vandeli*, here colonies might successfully compete with *M. scabrinodis* and reproduce by queen foundation or by colony fission, while at the edge of its range (defined by more onerous ecological conditions) queens might have to resort to temporary social parasitism of *M. scabrinodis* to establish a new colony. Ecologically Britain might be at the extreme edge of the range for *M. vandeli* so that it can reproduce only as a social parasite. This might explain why so few colonies have been found in Britain and why, despite considerable repeat searches at the Dorset site, no further colonies were located. A similar explanation might also account for the extremely patchy British distribution of *Formica exsecta* Nylander, which is believed to found colonies by temporary social parasitism of *Formica fusca* L. nests.

Ecology of *M. vandeli*

Myrmica vandeli requires wet and warm conditions at the nest site (see Elmes *et al.*, 1998); we noted that it appeared most abundant in a wet marsh at about 500 m in the Haute Rhône, where it lived in tussocks of grass and sedge. Very little difference between the nest sites favoured by *M. vandeli* and *M. scabrinodis* could be detected except that *M. vandeli* was perhaps, more abundant in the central, least shaded part of the site. At the site in the Haute Alpes (ca. 1800m) colonies were living in grass tussocks in a small wet "flush" in a hay meadow, created by a small spring. No obvious ecological difference could be detected here except that *M. vandeli* appeared to be favouring the slightly wetter areas compared to *M. scabrinodis* (Elmes *et. al.*, 1998). At a third site in the Massif Central colonies were living in grass tussocks in a small area of very wet grassland, here the *M. vandeli* colonies occupied tussocks more or less surrounded by water, whereas *M. scabrinodis* were more abundant in the slightly drier edges of the site.

The colony found in Dorset was living in a *Molinia* tussock in an area of boggy heathland surrounding a smaller area with permanent water. In most years the tussock containing the nest would be surrounded by water for much of the time, though when this occurred foraging workers could easily move from tussock to tussock via the vegetation. Many similar tussocks contained *M. scabrinodis* nests. The Welsh site was much more atypical in that the grass was shorter and nests (both *M. vandeli* and *M. scabrinodis*) were under flat stones, nevertheless the site was also quite moist. We found one colony of *M. vandeli* living in similar conditions, under a stone in moist alpine grassland in Switzerland and nests have reportedly been found in moss pads and under stones elsewhere (Seifert, 1988).

The common factor among sites seems to be wet, almost waterlogged habitats that become very warm in summer. Such places were fairly common in the foothills of the southern Alps where they were managed as hay meadows. However, they are becoming rarer as small marshes are either abandoned or drained. Suitably hot, wet conditions probably occurred locally throughout central Europe but were always rare in northern Europe. In Britain suitable habitat might be rare and restricted to the southwest. If the hypothesis of social parasitism is correct then British investigators might have to search many nests in the hottest marsh habitats before finding *M. vandeli*. Finally, if southern Britain gets significantly warmer as predicted by climate change models, *M. vandeli* might be one of the species that becomes more widespread.

Acknowledgements

We are grateful for the financial support of The Royal Society (Radchenko) and the EU Framework V, MacMan project (Elmes & Thomas).

References

Agosti, D. & Collingwood, C. A. 1987. A provisional list of the Balkan ants (Hym. Formicidae) and a key to the worker caste. 1. Synonymic list. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* **60**: 51–62.

Bernard, F. 1967. *Les Fourmis (Hymenoptera: Formicidae) d'Europe occidentale et septentrionale*. 411pp. Masson et Cie, Paris.

Bondroit, J. 1920. Notes diverses sur les fourmis d'Europe. *Annales de la Société Entomologique de Belgique* **59** (1919): 143–158.

Elmes, G.W. 1978. A morphomctric comparison of three closely related species of *Myrmica* (Formicidae), including a new species from England. *Systematic Entomology* **3**: 131–145.

Elmes, G.W. & Thomas, J.A. 1985. Morphometrics as a tool in identification: a case study on *Myrmica* from France. *Actes Colloques des Insectes sociaux* **2**: 97–108.

Elmes, G.W., Radchenko, A.G. & Aktaç, N. 2002. Four new *Myrmica* species (Hymenoptera: Formicidae) from Turkey. Annales Zoologici, **52**: 157–171.

Elmes, G.W., Thomas, J.A., Wardlaw, J.C., Hochberg, M., Clarke, R.T. & Simcox, D.J. 1998. The ecology of *Myrmica* ants in relation to the conservation of *Maculinea* butterflies. *Journal of Insect Conservation* **2**: 67–78.

Kutter, H. 1977. *Insecta Helvetica. 6: Hymenoptera Formicidae*. 298 pp. Fotorotar AG. Zürich.

Markó, B. 1999. New ant taxa (Hymenoptera: Formicidae) in the Romanian fauna. *Entomologica Romanica* **4**: 95–98.

Radchenko, A.G. & Elmes, G.W. A taxonomic revision of socially parasitic *Myrmica* ants (Hymenoptera, Formicidae) of Palaearctic Region. *Annales Zoologici* (in press.)

Sadil, J. 1952. A revision of the Czechoslovak forms of the genus *Myrmica* Latr. (Hym.). *Acta Entomologica Musei Nationalis Pragae* **27** (1951): 233–278.

Seifert, B. 1988. A taxonomic revision of the *Myrmica* species of Europe, Asia Minor, and Caucasia (Hymenoptera, Formicidae). *Abhandlungen und Berichte des Naturkundemuseums Görlitz Abh. Ber. Naturkundemus. Görlitz* **62**: 1–75.

Seifert, B. 1996. *Ameisen: beobachten, bestimmen*. Naturbuch Verl., Augsburg.

Schlick-Steiner, B.C. & Steiner, F.M. 2000. Die Moorbewohnerin *Myrmica vandeli* Bondroit 1920: *Erstnachweis für Ostösterreich und Einsatz im Naturschutz.—Ameisenschutz aktuel* **14**: 113–115

Schönrogge, K., Barr, B., Wardlaw, J.C., Napper, E., Gardner, M.G., Breen, J., Elmes, G.W. & Thomas, J.A. 2002. When rare species become endangered: cryptic speciation in myrmecophilous hoverflies. *Biological Journal of the Linnean Society* **75**: 291–300.

Wheeler, W.M. 1910. *Ants: their structure, development and behavior*. 663 pp. Colombia University Press, New York.